CHINESE VIEWS OF INFORMATION WARFARE

John Arquilla, Associate Professor
Information Warfare Academic Group
Sponsors: Office of the Secretary of Defense and Defense Information Agency

OBJECTIVE: Explore the manner in which China is conceptualizing conflict in the information age.

SUMMARY: Both the information developed in the course of this study and the inferences drawn from it are classified, now in a code-word program. Two classified monographs have been delivered to the sponsors as of this writing.

THESIS DIRECTED:

Lee, D., "Command, Control, and the Defense of Taiwan," Master Thesis, Naval Postgraduate School, March 2000.

DoD KEY TECHNOLOGY AREAS: Other (Information Warfare)

KEYWORDS: Information Age, China

CYBERTERROR

John Arquilla, Associate Professor
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Sponors: Defense Information Agency and Joint Security Operations Command

OBJECTIVE: To develop strategy and doctrine for defending against or countering cyberterror.

SUMMARY: This research examines strategic and doctrinal issues across the spectrum, from cyberspace-based electronic attack to more exotic microwave and radio frequency weapons. It also examines the use of cyberspace for what might be called "combat support" functions. One classified thesis examined defensive anti-cyberterror strategies, the other focused on proactive measures that can be taken against cyberterror.

DoD KEY TECHNOLOGY AREAS: Other (Cyberterror)

KEYWORDS: Cyberterror, Cyberspace-Based

DETERRING REGIONAL AGGRESSORS

John Arquilla, Associate Professor
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Sponsor: Deputy Chief of Staff for Operations

OBJECTIVE: Provide support for the national military strategy of being able to wage two major theater wars nearly simultaneously.

SUMMARY: The project consisted of developing a framework for deterring multiple adversaries, then working with regional CINCs to implement the information operations that would support the strategies developed. The work was briefed both to regional CINCs and to the NCA, whose approval was required for the work to be undertaken. A Top Secret code-word level report was prepared for the sponsor.

DoD KEY TECHNOLOGY AREAS: Other (Military Strategy)

KEYWORDS: Theater WARS, Deterrence, Military Strategy

THE ILLICIT SMALL/LIGHT WEAPONS TRADE

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Sponsor: Defense Information Agency

SUMMARY: This was a case study of a particular country's involvement in the abovementioned trade. This work was briefed to the sponsor, as well as to the State Department ambassabor in charge of this problem. This has resulted in a course of action being developed to deal with the country in question. A Top Secret code-word level report was prepared for DIA.

DoD KEY TECHNOLOGY AREAS: Other (National Security)

KEYWORDS: Weapons Trade

RESEARCH AND ANALYSIS OF TERRORIST INFORMATION OPERATIONS (RATIO)

John Arquilla, Associate Professor
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Sponsors: Defense Information Agency and Joint Security Operation Command

SUMMARY: This program undertakes a variety of research tasks on behalf of the sponsors, extending to: study of the information technology acquisition patterns of a number of terrorist groups; maintenance of a database of cyber-terror incidents, as well as tools and devices; and field study of former terror group members. In FY 00, seven technical reports prepared under the auspices of the Center for the Study of Terrorism and Irregular Warfare were submitted to the sponsors, along with a comprehensive database of incidents of cyberterror and related tools and devices.

DoD KEY TECHNOLOGY AREAS: Other (Terrorism)

KEYWORDS: Irregular Warfare, Information Technology Acquisition

NPS STUDENT AND FACULTY HIGH POWER MICROWAVE RESEARCH

CAPT James Powell, USN, Military Faculty
Information Warfare Academic Group
Sponsor: Naval Research Laboratory

OBJECTIVE: The purpose of this research is to continue development of high power microwave (HPM) and Ultra-Wideband (UWB) technology and capabilities research at the Naval Postgraduate School including source and systems engineering and design, modeling and simulation, and effects testing. This work will have application to ship defense, Information Warfare/Information Operations (IW/IO), and suppression of enemy air defenses (SEAD). Deliverables will include these and NPS technical reports.

DoD KEY TECHNOLOGY AREAS: Directed Energy Weapons

KEYWORDS: HPM, Ultra-Wideband, Directed Energy Warfare, Radio Frequency Weapons, Non-Nuclear Electromagnetic PU

EA-6B FOLLOW-ON PLATFORM CAPABILITIES STUDY

CAPT James Powell, USN, Military Faculty
Information Warfare Academic Group
Russell W. Duren, Associate Professor
Department of Aeronautics and Astronautics
Sponsor: Chief of Naval Operations (N88)

OBJECTIVE: This study is tasked to support N88 requirements definition in the Airborne Electronic Attack (AEA) Analysis of Alternatives (AoA) process by outlining and prioritizing technical alternatives for future TACAIR Electronic Attack, and by developing a roadmap to use in the conduct of the EA-6B Follow-on Platform AOA.

SUMMARY: Research was completed providing surveys of available information and systems that could be used to support the AEA AoA. A report was completed that surveyed previous AEA studies. The report summarized classified and unclassified studies from the time period of 1992 through 1999. It concluded with recommendations for future research. A set of surveys was performed as part of a master's thesis. These surveys examined a wide range of existing and proposed systems for potential use in an AEA system of systems. Systems that were surveyed included UAV and UCAV platforms; avionics payloads for reconnaissance, SIGINT, and various forms of electronic attack; and smart weapon platforms for SEAD and DEAD missions.

OTHER:

Duren, R. W., "Report on Previous Studies Related to the EA-6B Follow-on Platform," paper provided to the AEA AoA Technical IPT, 5 June 2000.

THESIS DIRECTED:

Nance, L., "EA-6B Follow-On Study: UAVS and UCAVS," Master's Thesis, Naval Postgraduate School, March 2000.

DoD KEY TECHNOLOGY AREAS: Air Vehicles

KEYWORDS: EA-6B, Electronic Warfare, Prowler, SEAD, Shielding, Slot Antenna, Smart Weapons, Unmanned Combat Air Vehicles, UCAV, Unmanned Air Vehicles, UAV, Electronic Attack

DETECTION OF LPI RADAR SIGNALS

D. C. Schleher, Professor
Department of Electrical and Computer Engineering and Information Warfare Academic Group
Sponsor: National Reconnaissance Office

OBJECTIVE: To design and synthesize an ELINT receiver capable of detecting LPI radar signals with the same sensitivity as available on equivalent conventional pulsed signals. To accomplish this detection in the presence of a large number of interfering conventional pulsed radars and to measure the radar's mode, allowing the operating range of the LPI radar to be determined.

SUMMARY: An adaptive LPI Radar Detector was previously synthesized and successfully simulated. As determined by simulation, it provided an operationally significant range of 60 km on a known LPI radar signal. In addition, it determined the LPI radar's mode. A temporal mask approach was used to allow detection of the LPI radar signal in the presence of over 500 Furuno radars with random modes. An experimental demonstration was successfully conducted that confirmed the theoretical design. The experiment used a threat simulator that radiated synthesized LPI radar signals. The LPI signals were intercepted by a Low Noise Receiver and A/D converted using a 250 MHz Gage Digital Sampling Oscilloscope. The signal was than processed in a digital signal processor using MATLAB code. LPI signals at a level of -102 dBm were detected and the radar's mode determined.

THESIS DIRECTED:

Teng, H. and Ong, P., "Digital LPI Radar Detector," Masters Thesis, Naval Postgraduate School, March 2001.

DoD KEY TECHNOLOGY AREAS: Other (Surveillance)

KEYWORDS: SIGINT, LPI Radar, Digital Pulse Compression

MISSILE IMU MODEL

D. C. Schleher, Professor
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Sponsor: Naval Air Warfare Center-Weapons Division

OBJECTIVE: To develop IMU models that allows a missile's attitude to be determined from telemetry data provided by rate sensors aboard the missile. One model is to be developed for non-rolling missiles that use IMU quartz rate sensors. A second model is to be developed for a rolling missile that uses magnetohydrodynamic rate sensors and a magnetoresistive spin sensor. The model is to provide outputs that are within 2 degrees of the actual missile attitude. A three-dimensional animation of the missile's attitude is to be provided.

SUMMARY: SIMULINK models were successfully developed for both the rolling and non-rolling missiles. The models were calibrated using Carco Table test data that matched expected values to within 2 degrees RMS on each axis. An animation capability was developed that allowed the resulting accurate attitude profile to be visually observed.

The models accept digitized strapdown telemetry data that represent distorted rate sensor data. The non-rolling missile model compensates for the distortions and then applies these data through an Euler transformation to convert the strapdown rates to earth-referenced attitude measurements. An alternate Quaternion model is also provided that allows the model to function at all missile attitudes.

The rolling missile model includes a quadrature spin demodulator that extracts the strap down rates from the telemetry data. The spin demodulator is driven by an arc tangent demodulator that is synchronized to a magnetroresistive spin sensor. It was determined that the ATA ARS-04E rate sensors were ineffective in this application. These were replaced by Tokin CG-16D sensors that exhibited good performance.

THESES DIRECTED:

Johnson, T., "Computer Modeling of Jamming Effects on Infrared Missiles," Master's Thesis, Naval Postgraduate School, June 1999.

Hill, C., "Computer Modeling of Jamming Effects on Roll Stabilized Missiles," Master's Thesis, Naval Postgraduate School, September 2000.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: Missile Attitude, SIMULINK, IMU

POSITIONAL ACCURACY OF TDOA MISSILE SYSTEM

D. C. Schleher, Professor
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Sponsor: Naval Air Warfare Center-Weapons Division

OBJECTIVE: To analyze and synthesize an FDOA/TDOA system capable of providing one-meter RMS position accuracy from telemetry signals radiated from a test missile during flight test. Also, to investigate

the accuracy of a Time, Space and Position Information (TSPII) system developed by NAWC-Weapons Division.

SUMMARY: A lower bound on the accuracy achievable using a nine base station configuration, employed at White Sands Missile Range, as a function of signal-to-noise ratio was determined. The simulation used a missile trajectory determined from measured laser tracker data. The methodology used in the simulation was to determine FDOA from each base station with respect to the reference station and then to use this to determine the TDOA of the missile. This was used in the Smith-Able algorithm to determine the position of the missile. A signal-to-noise ratio of 40 dB was required to achieve a one-meter rms positional accuracy of the missile's location. The TSPI system was found to be limited by the susceptibility of the zero crossing counter to noise and fading and the use of a wideband telemetry signal source in the missile. A system using a stable source in the missile modulated by a pseudo noise code was synthesized. This is currently under investigation using modeling and simulation techniques. An experimental test of this system is planned.

THESES DIRECTED:

Klaszky, R., "Analysis of the Positional Accuracy of a Range Difference Missile Position Measuring System," Master's Thesis, Naval Postgraduate School, September 2000.

Heng, C., "Kalman Filtering of FDOA/TDOA Missile Tracking System," Master's Thesis, Naval Postgraduate School, March 2001.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: TDOA, FDOA, Missile Location, TSPI

ANTI-ACCESS SYSTEMS STUDY

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John Osmundson, Associate Professor
Command, Control, Communications, Computers, and Intelligence Academic Group
Robert Harney, Senior Lecturer
Department of Physics
Sponsor: Naval Warfare Development Command

OBJECTIVE: To determine systems and technologies that may pose disruptive threats to U. S. Naval forces when the systems and technologies are used in a mode whose function is to deny U. S. forces access to land and ocean areas.

SUMMARY: A large number of technologies and systems were examined for their potential to provide a disruptive influence on the capability of U. S. Navy forces to exert sea and area control and power projection in the Littoral region. Systems were ranked relative to their impact and likelihood of occurrence while risk was determined as the product of these factors. Twenty-four systems ranked high in both impact and likelihood, sixteen systems exhibited medium risk while seventeen systems were ranked as low risk. Technology and disruptive systems were generally categorized into delivery systems, logistics, attack mechanisms, counter measures, sensors, weapon types and cyber warfare. In addition, sixteen disruptive systems are described in detail. These include High Energy Laser Weapons, Naval Glide Bombs, GPs Jamming, Microwave Weapons, Mini and Micro Air Vehicles and Unmanned Combat Air Vehicles.

DoD KEY TECHNOLOGY AREAS: Other (Disruptive Technologies)

KEYWORDS: Area Access Denial, Disruptive Technology, Threats